The Magnetic Field Produced by a Flight of Charged Particles: R. W. WOOD and HAROLD PENDER, Johns Hopkins University. Read by title.

Note on the Thermal Unit: H. T. BARNES, McGill University. Read by title.

On the Action of a Condenser in an Induction Coil: J. E. IVES, University of Cincinnati. Read by title.

Note on a Graphical Method for Tracing Rays Through Optical Prisms: WILLIAM FOX, College of the City of New York. Read by title.

On a New Half-shade Polariscope: D. B. BRACE, University of Nebraska.

An Explanation of the Faraday and Zeeman Effects: D. B. BRACE. Read by title.

Additional Notes on the Construction and Use of the Brace Spectrophotometer: S. B. TUCKERMAN, University of Nebraska. Read by title.

E. F. NICHOLS,
Secretary pro tem.

THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

THE tenth annual meeting of the Society was held at the Carnegie Institute, Pittsburgh, Pa., on June 27 and 28, 1902. The attendance was larger than at any meeting since 1898 and the interest was so well maintained that the attendance at the four sessions did not vary ten per cent. Thirty-four applicants were elected to membership, making the total 287.

At the opening session the members were deeply grieved at the announcement by the President of the sudden death of Professor John Butler Johnson, Dean of the College of Engineering, University of Wisconsin, the notice of which appeared in the Pittsburgh press the evening before. Professor Johnson was one of the founders of the Society, a past president, and its first secretary. His enthusiasm, influence and active work for the Society were prominent factors in its development and usefulness, and he expected to be present at the Pittsburgh meeting, and, as usual, to take part in the discussions.

After the transaction of general business the President, Professor Robert Fletcher, Director of the Thayer School of Civil Engineering, read his address on 'The Efficiency Factor in Engineering Education.' After referring to the object of the Society an analysis of the membership was given which showed that 10 per cent. are practicing engineers who are not teachers, about 18 or 20 per cent. are both teachers and practitioners, 45 to 47 per cent. are teachers only or chiefly in civil, mechanical, electrical, mining and other departments of engineering, about 3 per cent. are identified mainly with instruction in pure technics, such as manual training, etc., while about 21 per cent. give the indispensable and fundamental preparation in mathematics, mechanics and the physical sciences. Another division gives 33 per cent. as committed to civil, 22½ per cent. to mechanical, 11 per cent. to electrical, and 9½ per cent. to mining and other branches of engineering. The balance of 24 per cent. constitute the teachers in preparatory courses and the practicians. An analysis was then made of the character of the 179 papers and reports by members and committees, respectively, which, together with the discussions, are printed in full in the nine volumes of *Proceedings*. Attention was called to the distinction between engineering and technology and the inconsistencies between the titles and performances of many engineering and technical colleges or schools.

The factor of efficiency in engineering education was regarded as influenced and

determined by the purpose in view, the personnel, both of teachers and taught, the substance and methods of instruction, and the machinery and cost. A lack of purpose characterizes too much of the secondary education where education itself is regarded as an end instead of a means, while the extreme type of training is given in the military and naval academies, whose definite aim is to raise up a body of officers fitted to command men. In discussing the time to be devoted to the college and professional courses, the statement was made that the regular college courses are not made effective enough even for culture.

With respect to the personnel of the teachers, it was held that, while a teacher of engineering must be primarily a teacher, he is not simply a pedagogue, but has much in common with the engineer in practice. To be efficient he must give inspiration and direction, and know his students. There must be mutual respect, confidence and sympathy. The element of command should accompany his direction and instruction. The habit of obedience should be formed in the student, for disobedience may be as fatal 'on the works' as in the army. The quality of the student material should be determined not simply by the academic test of the requirements for admission, but also by the test of character. Those who are not found to be entirely trustworthy should be promptly excluded.

As to the substance and methods of instruction the larger and ever-increasing work required of engineering colleges today demands that it be a more powerful agency. The principle of concentration is to be applied, since the range of primary and essential topics is so much greater than formerly that there is no room for non-essentials. The student's tasks should relate chiefly to that which he must learn while a student. The recitation should be used whenever practicable, the lecture method but seldom. What the student really gains comes from his own study of the book or of full notes, and by hard thinking. The coordination of subjects, as to both sequence and quantity, is of equal importance with the principle of concentration. Electives in a well-balanced curriculum should be restricted to a few courses in which the studies are entirely adapted to ends clearly defined. The principle of continuity follows that of coordination, and its application shows that it is a disadvantage to sandwich preparatory and culture studies between engineering studies.

Machinery as related to efficiency in engineering education includes all instruments, apparatus, machines, models, etc. Efficiency is determined by sufficient every-day exercises, with due regard to proper limitations of accuracy. There is not time enough for the student to acquire familiarity and facility with machines beyond those of fundamental utility. In modern engineering operations the principal criterion of efficiency is cost. The annual appropriations for the national military and naval schools represent the interest on a principal far greater than the endowment of any American university. Sufficient endowments to render an institution independent of income from students would limit classes by stricter standards of merit only, and avoid the lessened efficiency implied in large classes with inadequate teaching force. The tendency to expend too much in expensive buildings lessens the funds available to secure the best men as teachers. The principle to govern should be: good men at any price, a good plant at the least cost consistent with utility. The final estimate of the cost goes beyond the outlay of money and cannot be made until the professional development of the graduates is in evidence. Here, as elsewhere, the prime principle of the engineering profession is to derive the largest and best output possi-

ble from the judicious expenditure of money and labor.

The President's address was followed by a very interesting discussion on 'The Value of Non-resident Lectures on Engineering Subjects.' The three written discussions were by Professors William D. Pence, George F. Swain and Robert H. Thurston. In brief, such lectures, as a rule, were regarded as having but little value as a means of education, their chief value being as a means of inspiration and suggestion to the students, and of legitimately advertising the institution; keeping it in touch with the profession and extending its influence. They are also valuable to the local members of the faculty, in giving them additional opportunities to come in contact with engineers in active practice. As so much depends on the personality of the lecturer great care should be exercised in the selection.

At the afternoon session 'Methods of Grading Students in Engineering Colleges' were treated by Professor Charles P. Matthews, the practice of many colleges being given, as obtained by means of a circular letter containing ten questions.

Professor Francis C. Caldwell read a paper on 'Laboratory Notes and Reports,' in which stress was laid upon the necessity of impressing on the student the importance of original notes, and that this depended upon the shape in which they were taken down, and the care used in keeping them neat and clean so as to avoid copying. Attention was called to the danger of too great detail in the nature of printed report blanks, used to supplement the note-books and to make the students familiar with methods of making reports.

In the paper on 'Electrochemistry as an Engineering Course,' Professor Charles F. Burgess referred to the prominence of electrochemistry before the public through its progress along strictly scientific lines, as well as by reason of industrial development, which has been largely independent of the other. This subject may be taught as a science, perhaps included under the broader heading physical chemistry, or it may be taken up as a branch of engineering technology. The justification of establishing engineering courses in applied electrochemistry was considered, and an outline given of the studies that may properly be included in such work.

This paper was followed by an adjourned discussion of Professor Wm. G. Raymond's paper presented at the meeting in 1901, and which advocated some radical changes tending to reduce the course in engineering at least one year. The charge was made that by the present arrangement time was wasted: (1) By too much vacation, (2) by doing class work instead of work with the individual, and (3) by mixing engineering subjects with preparatory and general culture subjects. This discussion was lively and interesting, sixteen members taking part, those of Professors A. N. Talbot and C. L. Mees being written. Professor Talbot maintained that the vacations were educationally valuable to the students, as most of them engage in work of an engineering character, especially after the sophomore year, while others engage in business pursuits; that the instructors and younger professors engage in practice which fits them for better service, while others are making preparation for the following year's college work or in research. He also held that work with the individual was not applicable to information subjects, nor to foundation subjects where the quiz and class discussion secured better results; that where it was useful it was already employed, as in specialized courses, such as the design of structures, machines, etc., and that certain exercises require party work. Continuous work in one subject is in general unpedagogical. It was further claimed

that the segregation of engineering studies has been carried about as far as the condition of the preparatory schools permit, but that, essential as the training in general principles is recognized to be, it is advantageous to give some specialized courses of instruction.

At the Saturday morning session the first paper presented was that of Professor Elwood Mead on 'Courses of Instruction in Irrigation Engineering.' He described the magnitude and complexity of the industrial problems connected with irrigation in the West, and the need of engineers with special training not only to properly design the canals and other works with greater economy than was possible formerly, but also to administer the systems when established. The information upon which both laws and administrative practice must be based must be largely gathered by the engineer. The settlement of the arid region is already creating important problems in statesmanship and economics involving the relations of vested rights and the respective spheres of state and national authority. The State Agricultural College at Colorado was the pioneer in giving special courses of instruction relating to practical irrigation and the attendant business, social and legal problems. The paper gave the irrigation engineering course recently adopted by the University of California, and it was urged that other western colleges might advantageously adopt a similar course in providing for this need.

No abstract can give any adequate idea of the admirable paper as to both contents and style, by Professor Edward Orton, Jr., on 'The Subdivision of the Field of Chemical Engineering Education.' He gave the relative magnitude and increasing importance of the ceramic and cement industries, as well as those depending on metallurgical processes, and stated the need for men who should have a large part of the usual education of an engineer in combination with that of a chemist.

In discussing 'Some Abuses of the Lecture System,' Professor A. W. French gave five strong objections to the use of lectures to any material extent in giving instruction on engineering subjects, considering the present ample supply of text-books adapted to the needs of engineering colleges. The fact that the lecture system furnished the easiest method for the instructor to handle large classes was not regarded as a valid excuse, since it is the duty of large institutions to provide as adequate class instruction as is done by the small ones. It was recommended that in the few cases where lectures are properly used each student should be furnished with a copy or at least with full notes, so that his entire attention may be given to the thought presented in the lecture room.

At the afternoon session Professor C. M. Woodward read a paper on the 'Management of Intercollegiate Athletics,' which described some of the difficulties now encountered, and aimed at developing a higher moral standard in the actual conduct of intercollegiate athletics. A series of rules relating to eligibility of members of teams, etc., was given. A strong conviction was expressed that in some way the evils of gate fees at athletic contests and the large expenditures incident to training tables, extensive trips, etc., should be eliminated. In the discussion which followed a decided protest was raised against the undue encroachment of athletics on the legitimate work of many students who could not afford to make the sacrifice.

'Over-development in Engineering Laboratory Courses' was treated by Professor F. P. Spalding. He stated that the importance of laboratory instruction in all lines of scientific study, and its absolute necessity to any properly organized course in engineering, are generally conceded, but that the

rapid development of such instruction has led to some excessive application. In undergraduate courses the laboratory instruction should be based upon and carefully coordinated with the class room work, and not pursued as an end in itself. The attempt to introduce research work into undergraduate courses may often involve a serious waste of the students' time. With large classes and a scheme fully outlined by the instructor the student may easily fall into habits of careless and superficial reasoning. Really beneficial work of this character is only feasible to a very limited extent, under careful oversight, the student being required to fully discuss the results of his investigations. Objection was made to using a student's time to assist in making commercial tests in place of work in the regular course. The facilities for research presented by large laboratory equipments present an attractive field to graduate students, but immature young graduates should not be allowed to use too large a portion of their time in this manner.

The last subject considered was 'Excessive Differentiation in Engineering Courses.' Written discussions were given by Professors Marburg, Magruder and Allen, while Professor C. M. Woodward and nine others participated in the oral discussion. There was considerable difference of opinion expressed, although in many cases the speaker did not clearly state what was regarded as excessive differentiation. Some believed that a single general course should be given for all engineering students, while others maintained that civil, mechanical, electrical and mining engineers should have courses differing materially in the last two years and which also permit a limited amount of electives in the senior year. The former arrangement is contrary to the entire course of development of engineering education in this country, and it is interesting to notice that at this very meeting of the Society three separate pleas were made for still further differentiation, on the ground that the industrial development of the country demanded it.

Three of the committees of the Society made reports. That on technical books for libraries presented the objects of its work and pointed out some of the ways in which the libraries may assist in the promotion of engineering education. That on entrance requirements related to the formulation of entrance requirements. The committee expected to present a set of formulations to a similar committee of the National Educational Association at its Minneapolis meeting, July 7–11. The Committee on Statistics reported the number of students enrolled during 1901–02 at the different institutions in the different courses; the number of students pursuing engineering courses; the number and kinds of degrees conferred on engineering graduates to date by the different institutions; on the advisability of securing further statistics and the attitude of administrative officers in regard to furnishing the desired information, etc. Professor C. M. Woodward, of Washington University, was elected chairman of the Committee on Industrial Education, on account of the death of Professor Johnson, while Professor A. L. Williston was elected to fill the vacancy in the membership of the committee.

The Society, after considerable discussion and investigation, by a special committee appointed last year, decided at this meeting to appoint a 'Committee on Requirements for Graduation.' The President was authorized to take some time in selecting the members and the committee will be announced in a circular probably in September.

The following are the newly elected officers of the Society:

President, Calvin M. Woodward, Dean of the College of Engineering, Washington University.

Vice-Presidents, John J. Flather, University of Minnesota, and Frederick W. McNair, President of Michigan College of Mines.

Secretary, Clarence A. Waldo, Purdue University.

Treasurer, Arthur N. Talbot, University of Illinois.

Members of Council until 1905: William Esty, Lehigh University; Henry S. Jacoby, Cornell University; Lewis J. Johnson, Harvard University; Ellwood Mead, University of California; Edward Orton, Jr., Ohio State University, and William M. Towle, Syracuse University.

HENRY S. JACOBY,
Secretary (1901–2).

CORNELL UNIVERSITY.

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS.

THE fourteenth annual meeting of the Association of Economic Entomologists met in the West Room of the Lecture Hall, Carnegie Institute, Schenley Park, Pittsburgh, Pa., Friday and Saturday, June 27 and 28, 1902. The following papers were presented:

'Some Notes on the Use of Lime Salt and Sulphur and Resin Washes in Ohio': A. F. BURGESS, Columbus, Ohio.

(1) 'Experimental Work in New York State against the San José Scale'; (2) 'Observations on Certain Insects of Pine Trees': E. P. FELT, Albany, N. Y.

'Soluble Arsenic in Arsenical Insecticides': JOHN K. HAYWOOD, Washington, D. C.

'On the Study of Forest Entomology in North America': A. D. HOPKINS, Morgantown, W. Va.

'Recent Work against Shade-tree Insects': A. H. KIRKLAND, Boston, Mass.

(1) 'Résumé of the Search for the Native Home of the San José Scale in Japan and China'; (2) 'Present Status of the Imported Asiatic Lady-Bird Enemy of the San José Scale; its Possible Usefulness with the Native Lady-bird Beetle, *Chilocorus bivulnerus,* and the Natural Enemies, which may Check the Influence of Both Insects': C. L. MARLATT, Washington, D. C.

'Notable Insect Occurrences in Ohio for the First Half of 1902': H. OSBORN, Columbus, Ohio.

(1) 'Report of Experiments with the Lime, Salt and Sulphur Wash against the San José Scale in Maryland'; (2) 'On the Feeding Habits of the Adults of the Periodical Cicada': A. L. QUAINTANCE, College Park, Md.

'Egg-laying Record of Plum Curculio': A. L. QUAINTANCE and R. I. SMITH, College Park, Md.

'Results of some Recent Experiments against the San José Scale in Georgia': W. M. SCOTT, Atlanta, Ga.

'Notes from Delaware': E. DWIGHT SANDERSON, Newark, Delaware.

The following officers were elected for the ensuing year: *President,* Dr. E. P. Felt, Albany, N. Y.; *Vice-President,* Wm. H. Ashmead, Washington, D. C.; *Second Vice-President,* Professor Lawrence Bruner, Lincoln, Neb.; *Secretary and Treasurer,* Professor A. L. Quaintance, College Park, Md.

A. L. QUAINTANCE,
Secretary.

SCIENTIFIC BOOKS.

Ophthalmic Myology, a Systematic Treatise on the Ocular Muscles. By G. C. SAVAGE, M.D. Nashville, Tenn. 1902. Published by the author.

Dr. Savage's book is one that will doubtless gain a wide currency among ophthalmologists. Even those who differ with him the most widely must acknowledge the painstaking care, the thoroughness, the great ingenuity and the perfect sincerity which combine to make his work suggestive and valuable. Moreover, his long and ample experience in this special field gives him a certain right to speak with authority wherever practical questions are involved.

Among those who busy themselves with practical eye work, the book is sure to be widely read and quoted, and its teachings to find extensive, though not universal, acceptance. But for this very reason it becomes all the more necessary for the reviewer to point out what he cannot but regard as essential and considerable errors in the work. And if he confines himself mainly to this more ungracious part of his task, it is because the good qualities of the book speak for themselves and make encomium of them supererogatory.